

## THE LARVAE OF THREE NEARCTIC DIPTERA OF THE FAMILY PSYCHODIDAE

BY FRANÇOIS VAILLANT

UNIVERSITY OF GRENOBLE (FRANCE)

The *Pericoma* and the *Telmatoscopus* are hairy winged gnats, that are quite common in shady places, near a spring or a stream. The larvae of most species of these flies have a marginal habitat, at the limit between ground and water; they are found on a substrate covered only by a very thin layer of water; the substrate can be a stone, or earth, or a dead leaf soaked in water, or live moss. These larvae are "substrate eaters" and scrape the substrate in front of them as they move; they feed on organic particles; some devour tissues of decayed leaves.

Extensive work has been done on the imaginal stages of North American species of *Pericoma* and *Telmatoscopus*; they have been revised lately by L. W. Quate. But very incomplete is our knowledge concerning the immature stages, and especially the larval stages of these flies. Indeed the larvae of only 2 identified species of *Pericoma* have been described, those of *P. albitarsis* (Banks) by O. A. Johannsen in 1934, and those of *P. truncata* Kincaid by L. W. Quate in 1955; characters of the larvae of 7 unidentified species have also been given by O. A. Johannsen. At present we know the larvae of 2 nearctic species of *Telmatoscopus*; they are those of the cosmopolitan species *T. albipunctatus* (Williston), which is common to North and South America, to Europe, to Africa and to Asia; larvae of this species have been described successively by H. F. Efflatoun, E. Zavattari, S. Mukerji, O. A. Johannsen and F. X. Williams. Larvae of *T. superbus* (Banks) were found in the water of a hollow stump; one of them was figured by L. W. Quate.

The German entomologist H. J. Feuerborn showed that the best taxonomical characters, that can be used to distinguish the larvae of the different species of *Pericoma* and *Telmatoscopus*, are the number and position of setae on the body of these larvae. He discovered that the setae of Psychodid larvae are of two kinds, according to their base of insertion and to their constancy. Some of these setae, called "true setae," are movable and attached to

a sclerotized ring; the number of true setae is constant for all species of *Pericoma* and of *Telmatoscopus*, sensu stricto. The other setae, called "accessory setae," are not movable; they are not attached to a ring, but directly to the body wall, and their diameter decreases progressively from their base to their tip; their number and position, quite the same in all the specimens of a same species, differ from one species to another.

Later on, G. H. Satchell established a nomenclature of sclerotized plates and of setae that may be applied to all larvae of *Pericoma* and of *Telmatoscopus*. He described the larvae, new to science, of 9 European species of these two genera.

Recently, H. F. Jung, in his excellent revision of both immature and mature stages of European Psychodids, continued Satchell's work. Having assembled the larvae of many other species of *Pericoma* and *Telmatoscopus*, he was able to point out new and important taxonomical characters, such as the shape of the hypostomium.

In August 1955, in the Great Smoky Mountains, I collected larvae of two species of *Pericoma*, *P. marginalis* (Banks) and *P. albitarsis* (Banks), and those of a species of *Telmatoscopus*, sensu stricto. Unfortunately, I was not able to obtain imagos of this last species and it is therefore unidentified. I thought it might be useful to compare these larvae with those of the species of the Old World, so I describe them here in some detail, using the terms chosen by G. H. Satchell. First are given the characters common to all the larvae of *Pericoma* and to those of *Telmatoscopus*, sensu stricto, then those peculiar to each of the three species *Pericoma marginalis* (Banks), *Pericoma albitarsis* (Banks) and *Telmatoscopus* (*Telmatoscopus*) species I. Characters that are of no taxonomic value have been intentionally omitted.

At the start, I wish to express my thanks to Mr. E. A. Hummel, Superintendent of the Smoky Mountains National Park, who kindly permitted me to collect water midges, and also to Mr. A. Stupka, Park Naturalist, who in many ways helped me to secure those midges.

The head of a *Pericoma* larva is protected by a chitinous capsule, divided by a U shaped epicranial suture, into three parts: the mediodorsal frons, and the two genae on the sides.

The body is divided into three thoracic and eight abdominal



segments; each of these, with the exception of the eighth abdominal segment, is in turn divided by superficial constrictions into secondary segments or annuli. The first four segments of the body comprise only two annuli each, while the six following segments are divided into three annuli each. The last abdominal segment is not constricted; according to H. J. Feuerborn, it comprises three metameres fused together.

Each of the six thoracic annuli and of the twenty abdominal annuli is protected on its dorsal side by a large tergal plate. Some of them have also a small pleural plate on each pleurite, and two or four small sternal plates on their ventral side. Only the anterior annulus of each thoracic segment has a pair of pleural plates. The first and the last annuli of each of the first seven abdominal segments bear also a pair of pleural plates.

The last two annuli of each abdominal segment, save the eighth one, bear one or two pairs of sternal plates.

The three tergal plates of each of the abdominal segments, from II to VII inclusive, are conventionally called—in antero-posterior order—protergal plate, mesotergal plate and metatergal plate. For reasons, which I have given in a previous paper, I came to consider the anterior tergal plate of each thoracic segment and of the first abdominal segment as being the homologue of the mesotergal plate of each of the abdominal segments from II to VII; so I give it also the name of mesotergal plate. The first annulus of each of the four anterior segments of the body would be the homologue of the first two annuli of each of the abdominal segments from II to VII.

The last abdominal segment is protected dorsally and laterally by a large siphonal plate, which surrounds completely the segment on its distal part.

The anus opens on the ventral part of the last abdominal segment; it is surrounded by three plates, an anterior one, the preanal plate, and two posterior ones, the adanal plates.

All the plates we have mentioned, save the protergal plates of the abdomen, bear true setae. Some of these are small and usually ramose; they are probably sensory in function; we shall call them setulae. The other true setae are much larger and are usually unbranched. In many species, they retain around them either lime or particles of mud and that is why we shall call them tectorial true setae. Accessory setae of the tergal plates have

usually the same length and shape as the tectorial true setae and have probably the same function and though their origin is different, they are considered as tectorial also. Some larvae of *Pericoma* and *Telmatoscopus* have not the slightest coat of lime or mud, but have nevertheless long tectorial setae, true and accessory. As those larvae live in moss and in places where sometimes a swift current occurs, we can suppose that tectorial setae are used here to anchor the larvae to the moss. Indeed *Pericoma* larvae, that live on naked substrate and are covered with neither lime nor mud, have very short tectorial setae.

The basic arrangement of true setae on the head capsule and on the plates of the body is the same for all the larvae of *Pericoma* and *Telmatoscopus*, sensu stricto we know. The mesotergal plate of the first thoracic segment and the metatergal plates of both the second and the third thoracic segments each have seven pairs of true setae. The metatergal plate of the first thoracic segment and those of the first seven abdominal segments all bear six pairs of true setae. All the mesotergal plates of the body, save that of the first thoracic segment, have only three pairs of true setae.<sup>1</sup>

Each pleural plate of the thorax bears four true setae. The two anterior pleural plates of the first seven abdominal segments have each only one true seta, while the two posterior pleural plates of these same segments have each three true setae.

One or two true setae are inserted on each of the abdominal sternal plates.<sup>2</sup>

As for the siphonal plate of the last segment, it has six pairs of true setae. The preanal plate has two pairs and each adanal plate has two pairs.

A *Pericoma* larva is amphipneustic. Its anterior spiracles are prothoracic and open on each side of the posterior annulus, at the end of a projection of the body. The posterior spiracles

<sup>1</sup> In two European species of *Pericoma*, *P. calcilega* Feuerborn and *P. viperina* Vaillant, each abdominal mesotergal plate bears only two pairs of true setae; those of the third pair are not missing, but are inserted outside the plate.

<sup>2</sup> In addition to setae fixed on the plates, the first 10 segments of the body of a *Pericoma* or a *Telmatoscopus* larva have a few setulae and sensillae inserted on the body between the plates. As they have the same position in all larvae of *Pericoma* and *Telmatoscopus* and have no taxonomic value, I shall not insist upon them here.

open close to one another on the siphon, that is the distal part of the eighth abdominal segment; the spiracle-openings are surrounded by two dorsal and two ventral chitinous clubs, called flabellar processes. Each of these bears a row of long accessory setae, that are unwettable. The unwettable surface extending over the posterior spiracles, a small area of skin around them, and the accessory setae of the four flabellar processes, are called the flabellum.

The principal taxonomic characters used to distinguish larvae of the different species of *Pericoma* and *Telmatoscopus* are:

1—the shape of the head, the respective positions of its different true setae and of its callous places devoid of spines<sup>3</sup>;

2—the ornamentation of the hypostomium;

3—the respective positions of the true setae on the tergal plates and the different shapes of these setae;

4—the number, shapes, and respective positions of the accessory setae on the tergal plates;

5—the number and respective positions of the setae on the siphonal plate;

6—The respective lengths of the dorsal flabellar processes and of the ventral flabellar processes.

I shall now give the characters peculiar to each of the three species; the larvae described are all at the last instar. I shall also give some details concerning the habitat of the larvae of each species.

*Pericoma marginalis* (Banks)

Figures 1-7

Description: the head is about as long as wide; there are numerous stout spines behind each eye. The hypostomium has 25 to 30 teeth set in an irregular way.

The anterior spiracles are on long projection.

There are three pairs of setulae on the mesotergal plate of the first thoracic segment and on all the mesotergal plates of the abdomen; there are only two pairs of setulae on the mesotergal plates of the second and of the third thoracic segments and on all the metatergal plates of the body. All the other true setae of the tergal plates are tectorial; but they are of two kinds; some are leaf-shaped; the others are typical setae, circular in section. There is one pair of leaf-shaped true setae on each of the following plates: the second and third metatergal plates of the thorax and all the metatergal plates of the abdomen.

<sup>3</sup> On the figures, the surface of the head-capsule of a larva, between the callous places, is dotted, the callous places are not.



As for the accessory setae, they are of only one kind; they are all leaf-shaped; there is one pair of them on each of the second and third thoracic mesotergal plates, on each of the second and third thoracic metatergal plates, and also on each of the abdominal protergal plates; there are two pairs of leaf-shaped accessory setae on each mesotergal plate of the abdomen.

On the mid annulus of each abdominal segment, save the last one, each sternal plate bears two ramose setae.

The siphonal plate has no accessory setae, but only the usual six pairs of true ones; the dorsal true setae of the siphonal plate are small; the lateral ones are much larger.

The preanal plate has four long slender true setae, that are unbranched.

On each side of the preanal plate, there are two small lateral plates, each with two paranal setae. Similar lateral plates are found in all species of *Pericoma* known at present.

The ventral flabellar processes are more than twice as long as the dorsal flabellar processes.

Length of the larva, when extended: 4.5–4.9 mm.

The tectorial setae retain under them and around them a layer of mud particles, so that the larva is entirely hidden under a thick covering of dirt, which absorbs water and keeps the animal from getting dry. Even the head and the sides of the larva are concealed under the coat of mud, so that it is difficult to catch sight of the animal.

A very special feature of the larva of *Pericoma marginalis* is its set of leaf-shaped setae. Similar setae are found in no *Pericoma* larva of the old world. It is most interesting to ascertain that leaf-shaped setae have exactly the same size and the same shape, whether they are true or accessory. Feuerborn's expressed opinion that true setae are sensory in function is therefore indefensible.

Habitat: many larvae of *Pericoma marginalis* have been found on Dripping Rock Cliff, beside Roaring Fork Creek, at an elevation of about 2000 feet; some have been found also in other parts of the Smoky Mountains National Park. All were on vertical wet cliffs, either on a naked substrate or on rock covered by a thin coat of mud; all were in a shady place.

### *Pericoma albitarsis* (Banks)

Figures 8–15

Description: The larva of this species has already been described by O. A. Johannsen, but it is better to give more details in order to compare it with the larva of *Pericoma marginalis* and with larvae of other species.

The head, longer than wide, is especially broad behind the eyes; it is devoid of large spines. The hypostomium has two rows of sharp teeth; there are about 13 in the first row and 8 or more in the second row.

The projections bearing the anterior spiracles are short.

The number of true and accessory setae and their position is the same as for *Pericoma marginalis*.

All the accessory setae of the tergal plates are leaf-shaped. There is one pair more of leaf-shaped true setae than for *Pericoma marginalis*; it replaces a pair of typical setae and is on the metatergal plate of the first thoracic segment. The leaf-shaped setae are longer and narrower than those of the larva of *Pericoma marginalis*. All the true setae of the mesotergal plates, on the two posterior thoracic segments, are setulae. The sternal plates of the abdomen are quite similar to those of the first species.

The dorsal setae of the siphonal plate are small; the lateral ones are long and strong. The true setae of the preanal plate are flattened dorso-ventrally and are plumose on their sides.

Length of the larva, when extended: 4.7–5.0 mm.

The body is covered with mud, retained under the tectorial setae, but the coat is never as thick as it is in the larvae of *Pericoma marginalis* and it never hides the head, nor the sides of the body. On a few specimens collected in moss, there was hardly any mud at all.

Habitat: A few larvae were collected on Dripping Rock Cliff, but not in the same biotope as the larvae of *Pericoma marginalis*; they were in moss or on dripping rocks covered with a thin layer of diatoms. In several lotic biotopes on the roadside between Gatlingburg and Cades Cove, I found numerous larvae of the same species. Some were in the sun, creeping on wet rock covered with algae; others were in dripping moss.

### *Telmatoscopus (Telmatoscopus) species I.*

Figures 16–24

Description: The head is about as long as wide and has no large spines. The hypostomium has several rows of long and slender teeth; the first row is composed of about 30 elements.

The processes bearing the anterior spiracles are short.

The number of setulae on each tergal plate of the body is the same as for the larvae of *Pericoma albitarsis*; all the other true setae of the tergal plates are typical tectorial setae. There are 2 pairs of accessory setae on all the mesotergal plates of the body, save the anterior one, and on all the protergal plates of the abdomen. There is only 1 pair of accessory setae on the last 2 metatergal plates of the thorax. The first 2 tergal plates of the body and all the metatergal plates of the abdomen are devoid of accessory setae. The sternal plates of the abdomen are similar to those of the larvae of *Pericoma marginalis* and of *Pericoma albitarsis*.

The siphonal plate has 3 pairs of small true setae, 3 pairs of stout lateral true setae, and dorsally a pair of long accessory setae. The anal plate is separated transversally into 2 parts; its 4 true setae are unbranched and curved backwards; the hind part of the preanal plate has, on its posterior edge, a row of accessory setae, that are ramose. There are no lateral plates, but 2 pairs of paraanal setae, each on a small individual plate.



Length of the larva, when extended: 4.5–4.7 mm.

Habitat: Some larvae were found near Dripping Rock Cliff, at about 10 feet from the biotope, where the larvae of *Pericoma marginalis* were collected. There were a few larvae of *Pericoma albitarsis* among them. All were in dripping moss, and entirely clean.

*Telmatoscopus (Telmatoscopus) albipunctatus* (Williston)

I shall now complete the description of the larvae of *Telmatoscopus albipunctatus* (Williston)<sup>4</sup>, so that it may be compared to the diagnoses of the larvae of other American *Telmatoscopus*.

The head-capsule, quite smooth, is much longer than wide; it is widest at three fourths of its length. The hypostomium has only 3 large teeth, the medioventral one being the largest.

The thoracic respiratory horns are short.

The metatergal plates of the second and third thoracic segments have each 3 pairs of setulae; the metatergal plates of the abdomen have 2 pairs, and the mesotergal plates of the abdomen have only one pair. All the other true setae of the tergal plates are tectorial. There are accessory setae—1 pair—only on each protergal plate of the abdomen. On the abdomen, the mid-annulus of each segment has 2 pairs of sternal plates, with a seta on each one.

There are two pairs of accessory setae on the siphonal plate; they are anterior to the 4 dorsal true setae of this plate; all the setae of the siphonal plate are almost of the same size. The preanal plate is very conspicuous; it has the shape of an arrow-head pointed backwards; on its posterior edge, it is lined with long accessory setae flat and unbranched; its 4 slender unbranched true setae are near its posterior end and close to one another. The paraanal setae of the eighth abdominal segment are not inserted on plates, but on articular membranes.

Length of the larva, when extended: 8.5–9.0 mm.

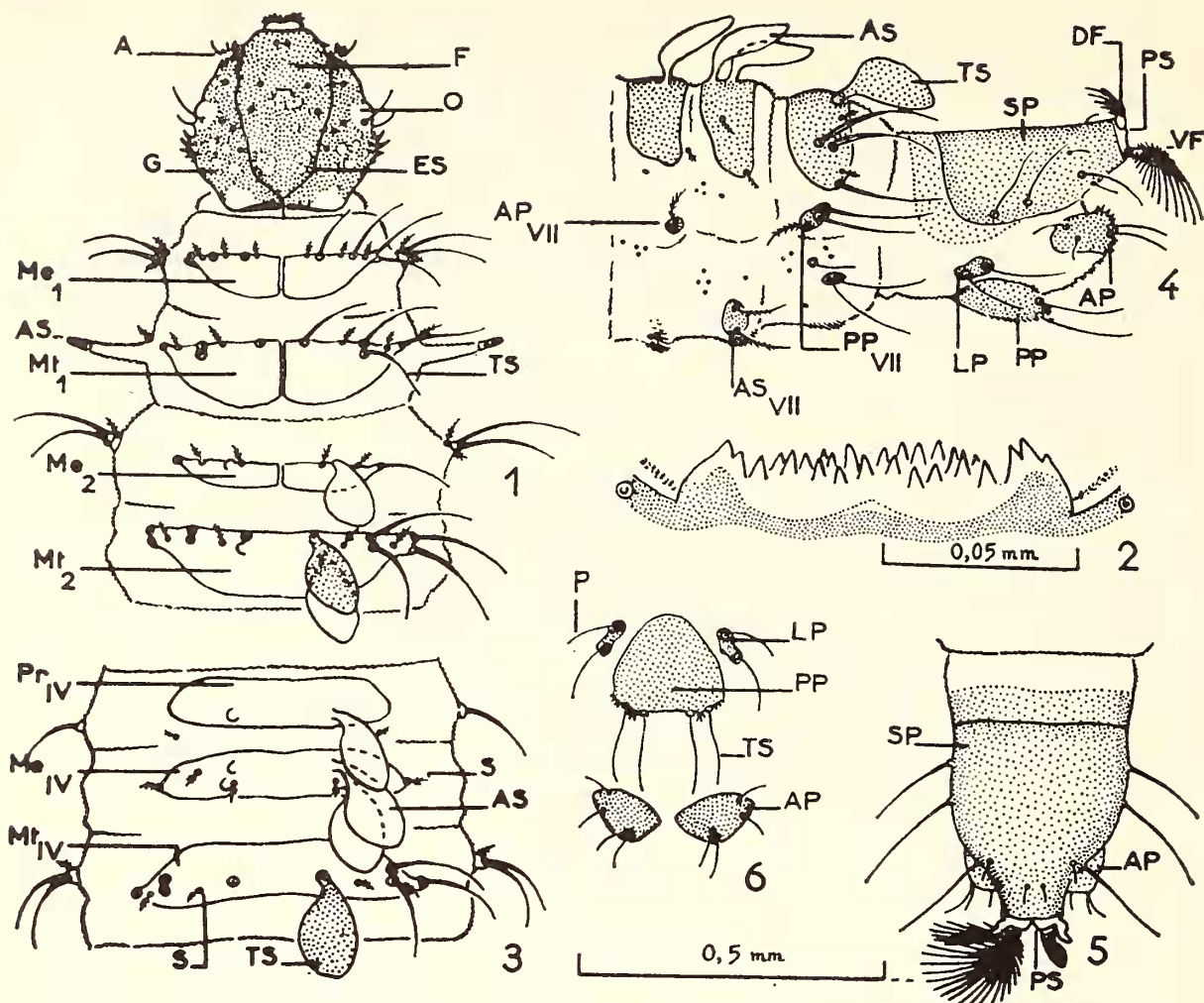
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<sup>4</sup>The larvae of *Telmatoscopus albipunctatus* described here were not found in America, but in small irrigation basins of a garden in Algiers, North Africa; they were collected October 3, 1948.



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Figures 1-6: larva of *Pericoma marginalis* (Banks). 1: head and two first thoracic segments, dorsal view. 2: hypostomium, ventral view. 3: fourth abdominal segment, dorsal view. 4: seventh and eighth abdominal segments, side view. 5: eighth abdominal segment, dorsal view; the setae of the right flabellar processes have not been figured. 6: plates surrounding the anus slit, outspread.

Conventionally, on figures 1 and 3, tectorial setae of the tergal plates have been omitted on the left side; only the basal ring of each tectorial true seta has been figured; only a bump has been figured at the location of each tectorial accessory seta. On figures 1, 3 and 4, leaf-shaped true setae are dotted, leaf-shaped accessory setae are not.

Figures 1, 3, 4 and 5 are on the same scale, indicated for figure 5.

A: antenna. AP: adanal plate. AP<sub>VII</sub>: anterior pleural plate of the seventh abdominal segment. AS: accessory seta. AS<sub>VII</sub>: anterior sternal plate of the seventh abdominal segment. DF: dorsal flabellar process. ES: epicranial suture. F: frons. FS: anterior spiracle or fore spiracle. G: gena. LP: lateral plate. Me<sub>1</sub>: mesotergal plate of the first thoracic segment. Me<sub>2</sub>: mesotergal plate of the second thoracic segment. Me<sub>IV</sub>: mesotergal plate of the fourth abdominal segment. Mt<sub>1</sub>: metatergal plate of the first thoracic segment. Mt<sub>2</sub>: metatergal plate of the second thoracic segment. Mt<sub>IV</sub>: metatergal plate of the fourth abdominal segment. O: ocellus. P: paraanal setae. PP: preanal plate. PP<sub>VII</sub>: posterior pleural plate of the seventh abdominal segment. Pr<sub>IV</sub>: protergal plate of the fourth abdominal segment. PS: posterior spiracle. PS<sub>VII</sub>: posterior sternal plate of the seventh abdominal segment. SP: siphonal plate or dorsal plate. TS: true seta. VF: ventral flabellar process.



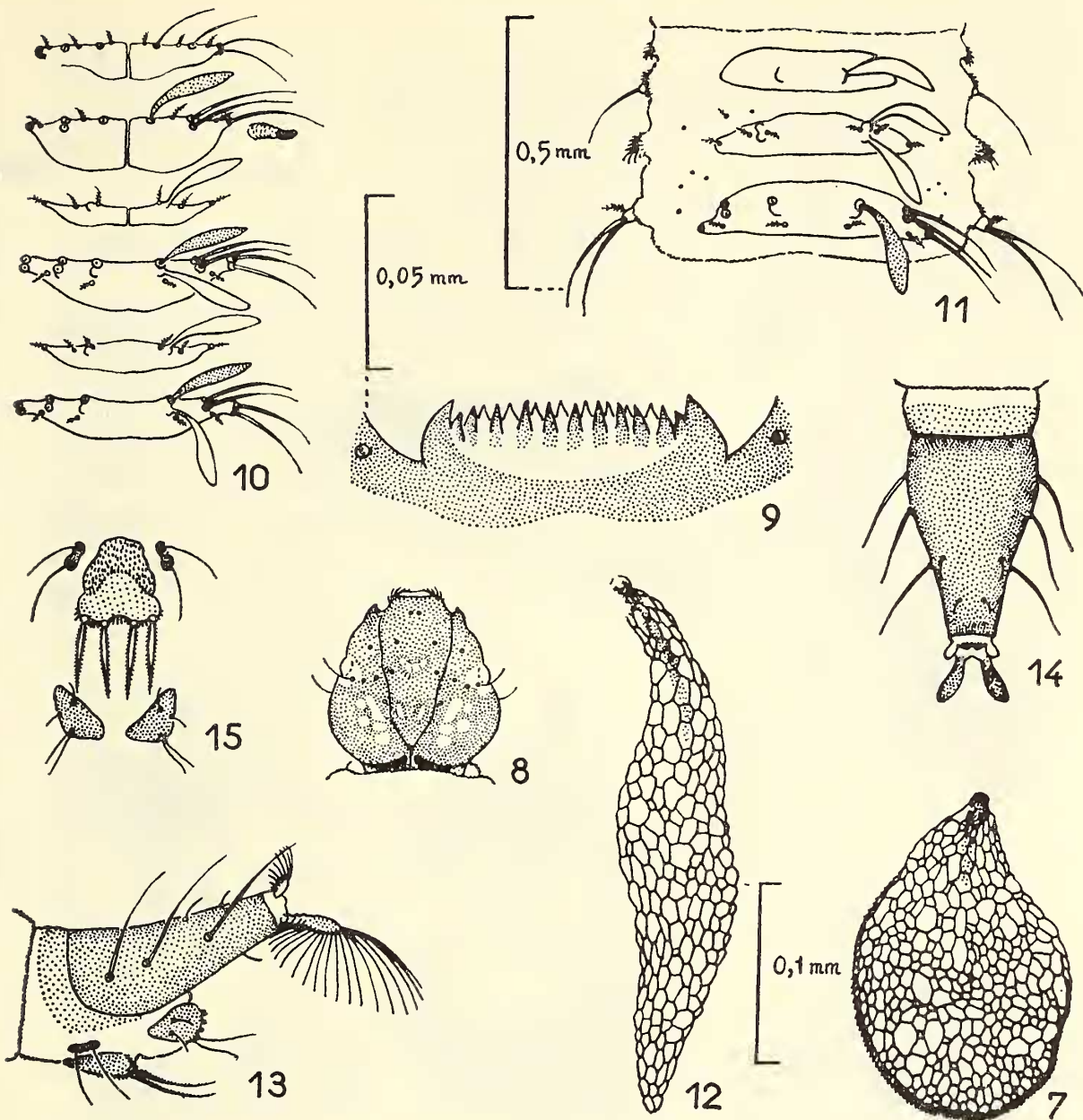
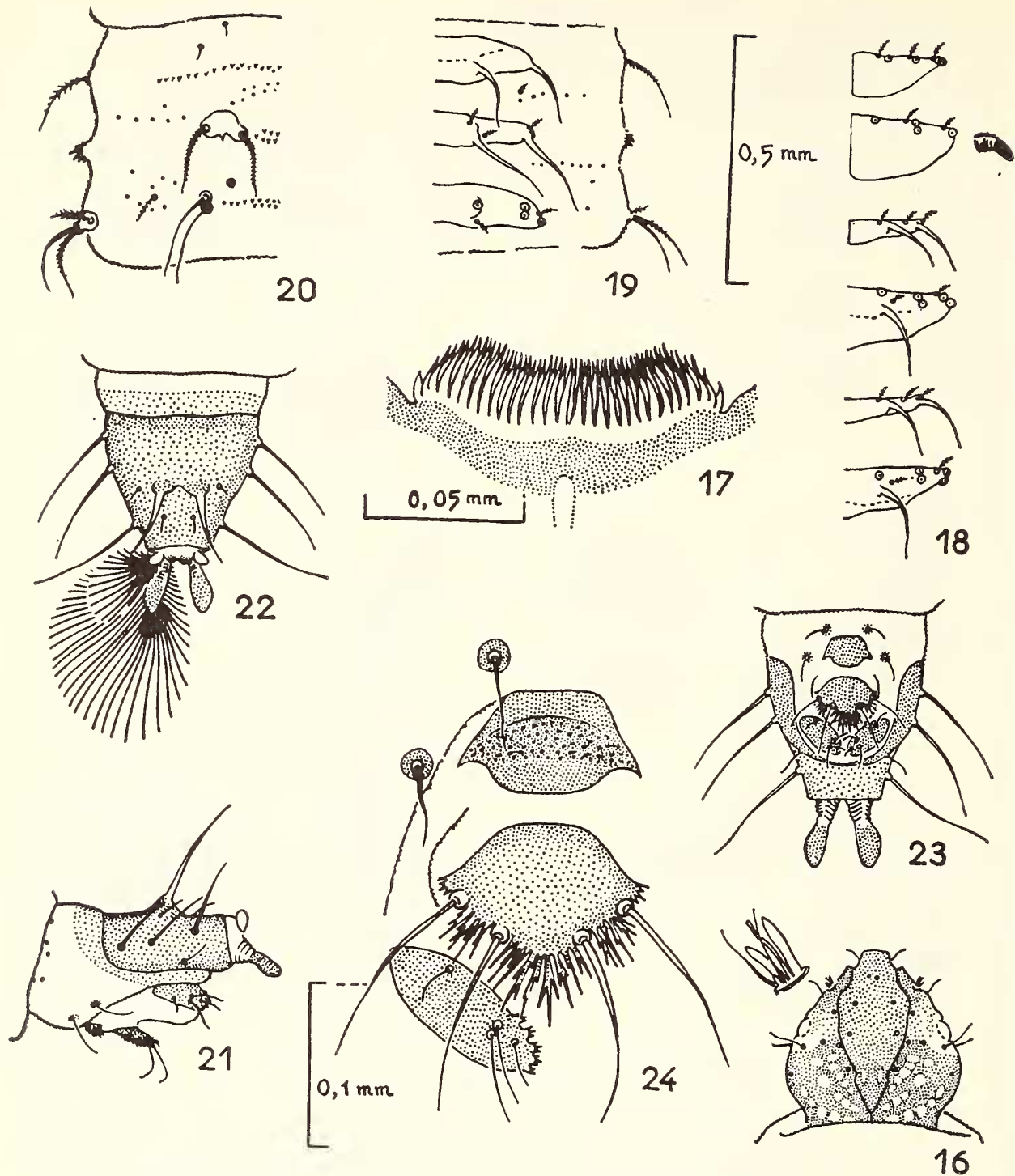


Figure 7: larva of *Pericoma marginalis* (Banks); true, leaf-shaped seta from the left side of the fourth abdominal segment.

Figures 8–15: larva of *Pericoma albitarsis* (Banks). 8: head, dorsal view. 9: hypostomium, ventral view. 10: thoracic tergal plates and right spiracle. 11: fourth abdominal segment, dorsal view. 12: true, leaf-shaped seta from the right side of the fourth abdominal segment. 13: eighth abdominal segment, side view. 14: eighth abdominal segment, dorsal view. 15: plates surrounding the anus slit, outspread.

On figures 10 and 11, tectorial setae of the tergal plates have been omitted on the left side; only the basal ring of each tectorial true seta has been figured; only a bump has been figured at the location of each accessory seta. Leaf-shaped true setae are dotted, leaf-shaped accessory setae are not.

Figures 7 and 12 are on the same scale. So are figures 8, 10, 11, 13, 14 and 15.



Figures 16-24: larva of *Telmatoscopus (Telmatoscopus) species I*. 16: dorsal view of the head, and left antenna enlarged. 17: hypostomium, ventral view. 18: right halves of the thoracic tergal plates and right spiracle. 19: right half of the fourth abdominal segment, dorsal view. 20: right half of the fourth abdominal segment, ventral view. 21: eighth abdominal segment, side view. 22: eighth abdominal segment, dorsal view; the setae of the right flabellar processes have not been figured. 23: eighth abdominal segment, ventral view. 24: plates surrounding the anus slit; the left adanal plate and lateral setae have not been figured.

On figures 18 and 19, tectorial true setae have been omitted; only their basal rings have been figured.

All the figures are on the same scale, save figure 17 and figure 24.